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(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Tetsuo YAMASHITA et al.

Application No.: 10/500,210

Confirmation No.: 2598

Filed: June 28, 2004

Art Unit: 2871

For: COLOR FILTER FOR LIQUID CRYSTAL DISPLAY AND SEMITRANSMISSION LIQUID CRYSTAL DISPLAY

Examiner: Wen Ying Patty Chen

DECLARATION UNDER 37 CFR 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Tetsuo YAMASHITA, a citizen of Japan residing in Shiga-ken, hereby declare under penalty of perjury as follows:

1. I am a named inventor of the above-identified patent application.

2. I have a doctor degree in science which was conferred upon me by the Graduate School of Tokyo Institutes of Technology in 1997. I majored in solid state physical chemistry in the graduate school.

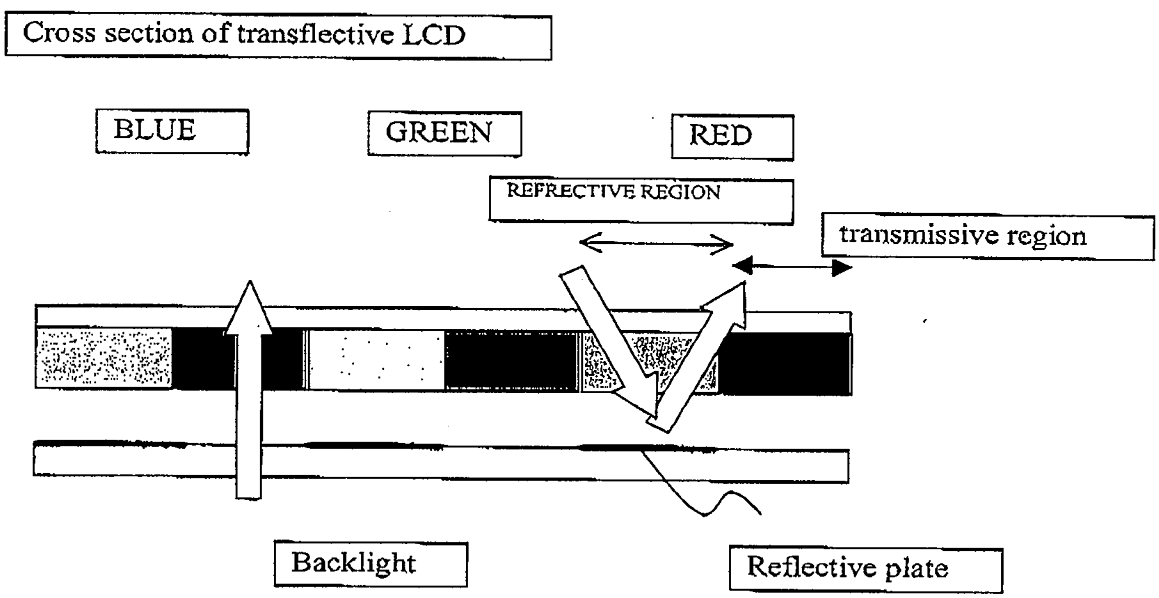
3. In 1997 I entered employment with Toray Industries, Inc., and since then have been a researcher in the Electronic and Imaging Material Research Laboratories (1997 - present). I have been engaged in research and development of high performance color filter for LCD. I am now a research associate in the Electronic and Imaging Material Research Laboratories and am thoroughly familiar with the art relating to materials for color filter and LCDs.

4. I have read and am familiar with the Official Action of September 28, 2007, and have also read U.S. Publication No. US 2001/0040654 to Koike, U.S. Patent No. 6,867,833 to Chang, JP 2001-281648 to Nakagi and U.S. Publication No. US 2002/0018159 to Kim.

5. This declaration is provided to explain how the claimed transflective liquid crystal displays that include the following combination of features: 1) a color filter having a transmissive region and a reflective region which are provided in each picture element of the color filter and which have colored layers comprising a single material, 2) a three-peak type LED backlight source being used as the backlight source, 3) and an aperture that is formed in the reflective region produce unexpectedly superior properties than displays lacking any of these elements.

6.1 Principle of transflective liquid crystal display (LCD)

FIG. 1



6.2 FIG. 1 shows a cross section of a transflective LCD. When a display is operating in a transmissive display mode, it turns on the backlight. The transmissive display mode is used when the environment is dark, for example indoors or outdoors at night. On the other hand, when the

environment is bright, for example outside in the daytime, it turns off the backlight. Only the environmental light is used in the reflective display mode. As shown above in FIG. 1, the environmental light passes through the color filter twice in a reflective display mode. Thus when in the reflective display mode, the display looks dark and deep when compared with the transmissive mode. That is, the expression of the LCD is different between the two type display modes, which is not preferable.

6.3 The inventors investigated several different solutions to this problem. In the first solution, the thickness of the reflective region is made thinner than the transmissive region. In the second solution, the darkness of the reflective region is made lighter than the transmissive region. That is, the pigment content of reflective region is decreased. In the third solution, an aperture is drilled into the colored layer of reflective region. As a result, the expression of the reflective display mode is lighter then ever.

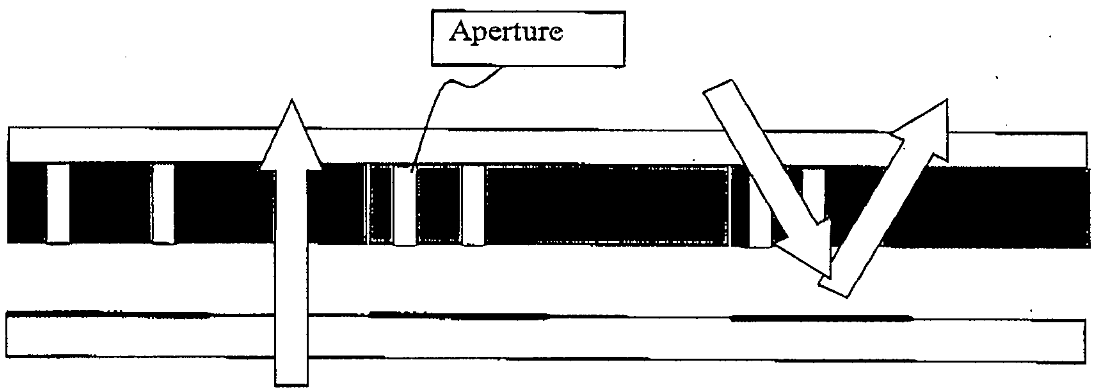
6.4 The first and second solutions, require different (thickness or darkness) in two layers of one color pixel. Accordingly, these solutions greatly increase the complexity in producing the displays. On the other hand, if the third solution is employed only one layer (of the same thickness) can be used and the aperture may be formed in the photolithographic process. This does not greatly increase the complexity in manufacturing the displays since the photolithographic process is already incorporated within the manufacturing process and the reflective and transmissive region are formed simultaneously within the same layer.

6.5 The inventors, however, discovered another problem with the third process. The aperture decreases the optical performance of the color filter. This is because the aperture passes unfiltered light of all wavelengths. An ideal color filter, however, should only pass the proper light. For example, RED pixel should only pass light within the 600-700nm wavelengths. Passing other wavelengths of light decreases the purity of the red color. Accordingly, the aperture leads to a decrease in the optical performance of the color filter. Thus, it was found that the aperture should

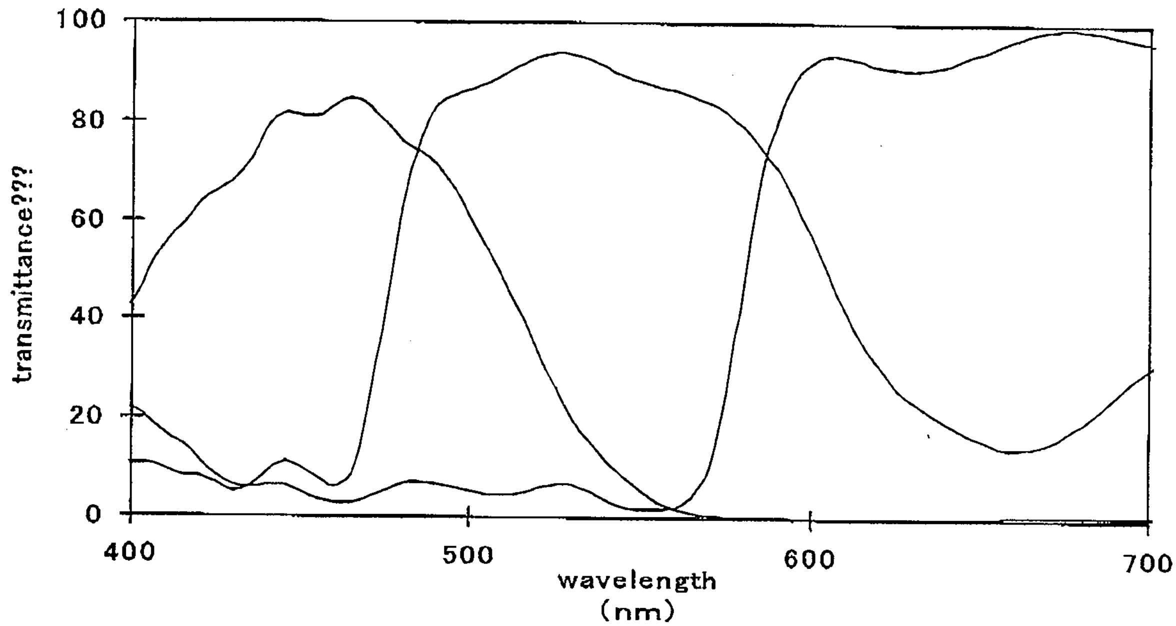
be as small as possible in the range of getting a desirable reflectance. But, as described above, when the aperture is small, the darkness expression of the LCD in reflective display mode is increased as described above. The inventors, however, found that if the thickness of the reflective layer is made thin and includes a small aperture, the problems described above are not encountered.

6.6 The claimed invention

FIG. 2 Cross section of claimed display

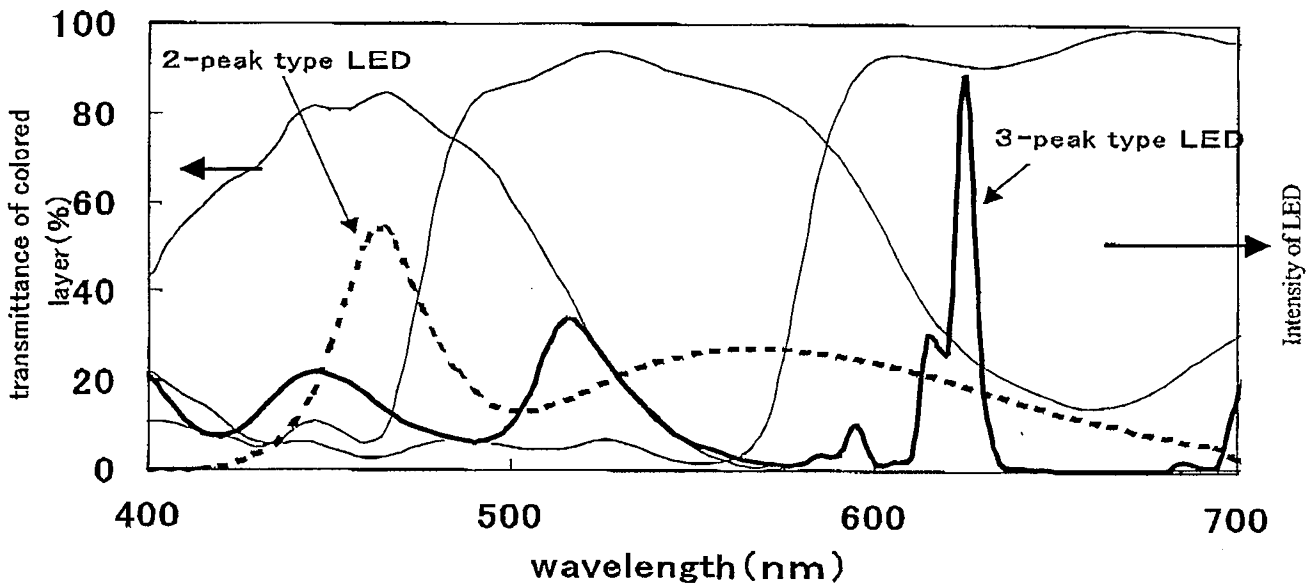


Transmittance of red green and blue color pixels



6.7 It was discovered that a 3-peak type LED backlight can be used to prevent the dark expression of the reflective display mode despite the use of the small aperture. This is counter intuitive because the 3-peak type LED does not turn on in the reflective display mode.

6.8 The 3-peak type LED backlight has the three spectrum peaks corresponding to RED GREEN and BLUE spectrum. When the maximum transmittance of RED, GREEN and BLUE color pixels correspond to the three spectrum peaks of the LED exactly, the ability of the backlight is maximized. Accordingly, the light intensity of the backlight is used most effectively when it is 3-peak LED backlight.



6.9 Because the light intensity of the backlight is used more effectively when it is 3-peak LED backlight, the colored layer does not need not to be made thick to filter extra wavelengths of the backlight. Rather it can be made thinner and can still achieve the conventional performance of a display.

6.10 The claimed display has the same thickness between the reflective and transmissive regions because they are formed simultaneously as the same layer. Thus when the thickness of the **transmissive region** is made thin, the thickness of reflective region is made thin too.

7 Accordingly, the inventors have overcome the defect of an aperture in the reflective display mode by utilizing a 3-peak type LED that is used only in the transmissive display mode. Utilizing a 3-peak type LED in a transmisive display with an aperture as claimed was not known at the time of the invention. Further, the benefits achieved by utilizing a 3-peak type LED in this setup would be completely unexpected to one of ordinary skill in the art.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct. Executed at Shiga, Japan, this 26th day of May, 2008.

By: Tetsuo Yamashita
Tetsuo YAMASHITA